Measurements of Deuteron $A(Q^2)$

- ❑ **What is $A(Q^2)$**
- ❑ **Why measure again?**
- ❑ **What was done by Vipuli D.**
- ❑ **Final results**
- ❑ **"To be done": June 04 data**

What is $A(Q^2)$?

- ❑ Deuteron has 3 elastic form factors (FF) (electric, magnetic, quadrupole).
- ❑ $A(Q^2)$ is a combination of all three.
- ❑ $\sigma = \sigma_m [A(Q^2) \cos^2(\theta/2) + B(Q^2) \sin^2(\theta/2)$
- ❑ $B(Q^2)$ is magnetic FF: small compared to $A(Q^2)$, and suppressed forward angles
- ❑ At small Q^2, $A(Q^2)$ proportional to $(Gep + Gen)^2$, so related to nucleon FFs.
- ❑ Most easily measured nuclear FF.

Why measure again?

❑ In region $0.6 < Q^2 < 1.7$ GeV^2, Hall A and Hall C measurements do not agree.

❑ Hall C was "byproduct" of T20 experiment. Used e-d coincidences with specialized spectrometers

❑ Hall A was early use of HRS's. Also coincidence experiment. Focused on high Q^2 where rates low, need coincidences to reduce background.

❑ Both systematic limited (not statistics)

Why measure again?
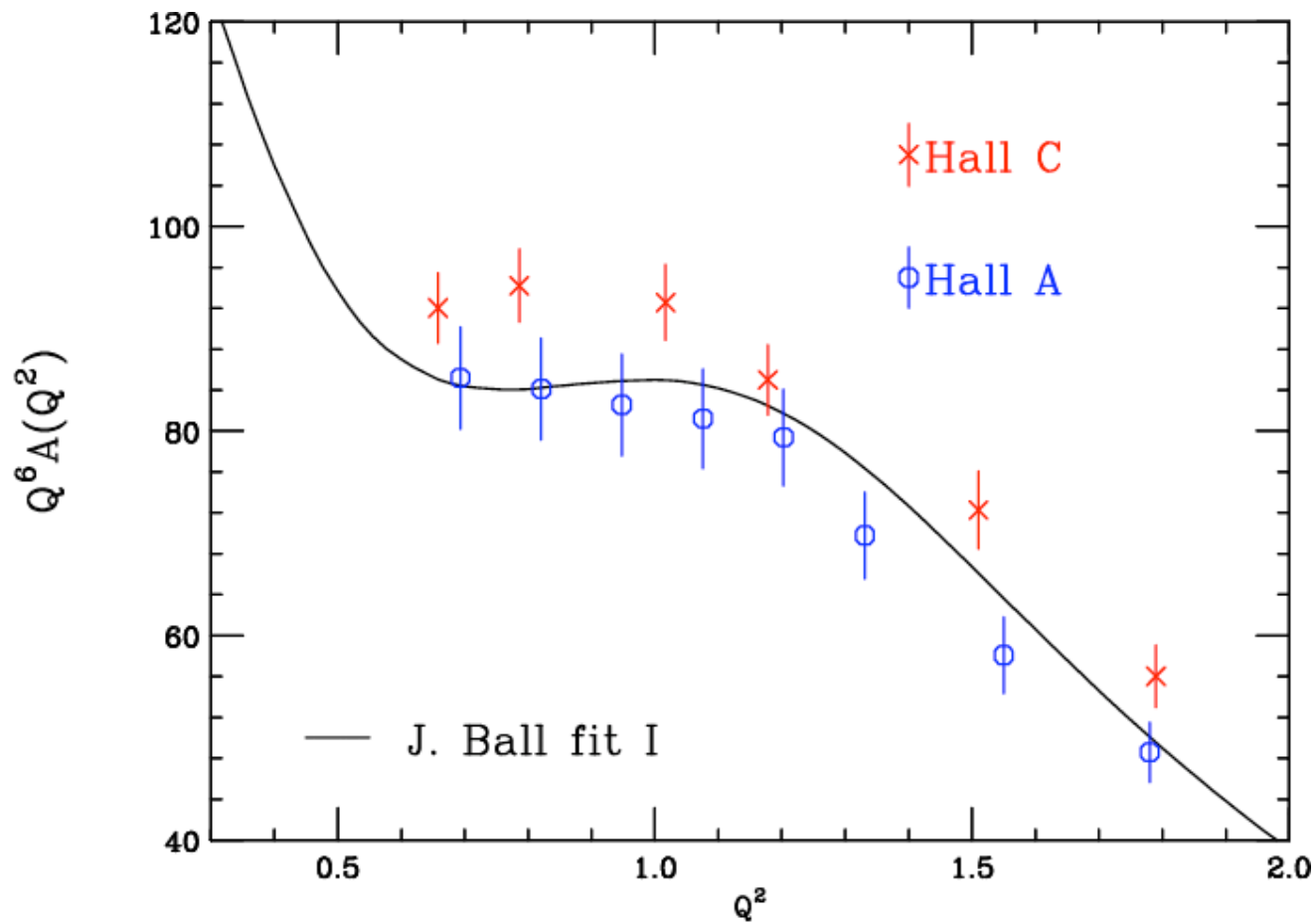
What was done

☐ **Measured ed elastic using electrons only (no coincidence). Used HMS.**
☐ **(First tried measuring deuterons only,but too much background).**
☐ **Ran in June 2004 (dedicated run of about one day) and January 2005 (part of Rd experiment needed for energy/angle calibrations, so almost "for free").**

What was done

❑ **June 04: measured Q^2=0.33, 0.55, 0.85, and 1.0 GeV^2 using E=2.04 GeV. (Q^2=1.25 in SOS, might be useful: not sure).**

❑ **January 05: measured Q^2=0.10, 0.38, 0.57, 0.70 using E=1.2 GeV, and Q^2=0.52, 0.72, 0.89, 1.02, and 1.25 using E=2.4 GeV.**

❑ **Systematics better in 1/05: also have ep and eC elastic peaks for energy/angle calibration, plus two E for check on B(Q^2)**

❑ **Usually 10K counts in ed elastic peak**

A typical W spectrum

$Q^2 = 1\ GeV^2$
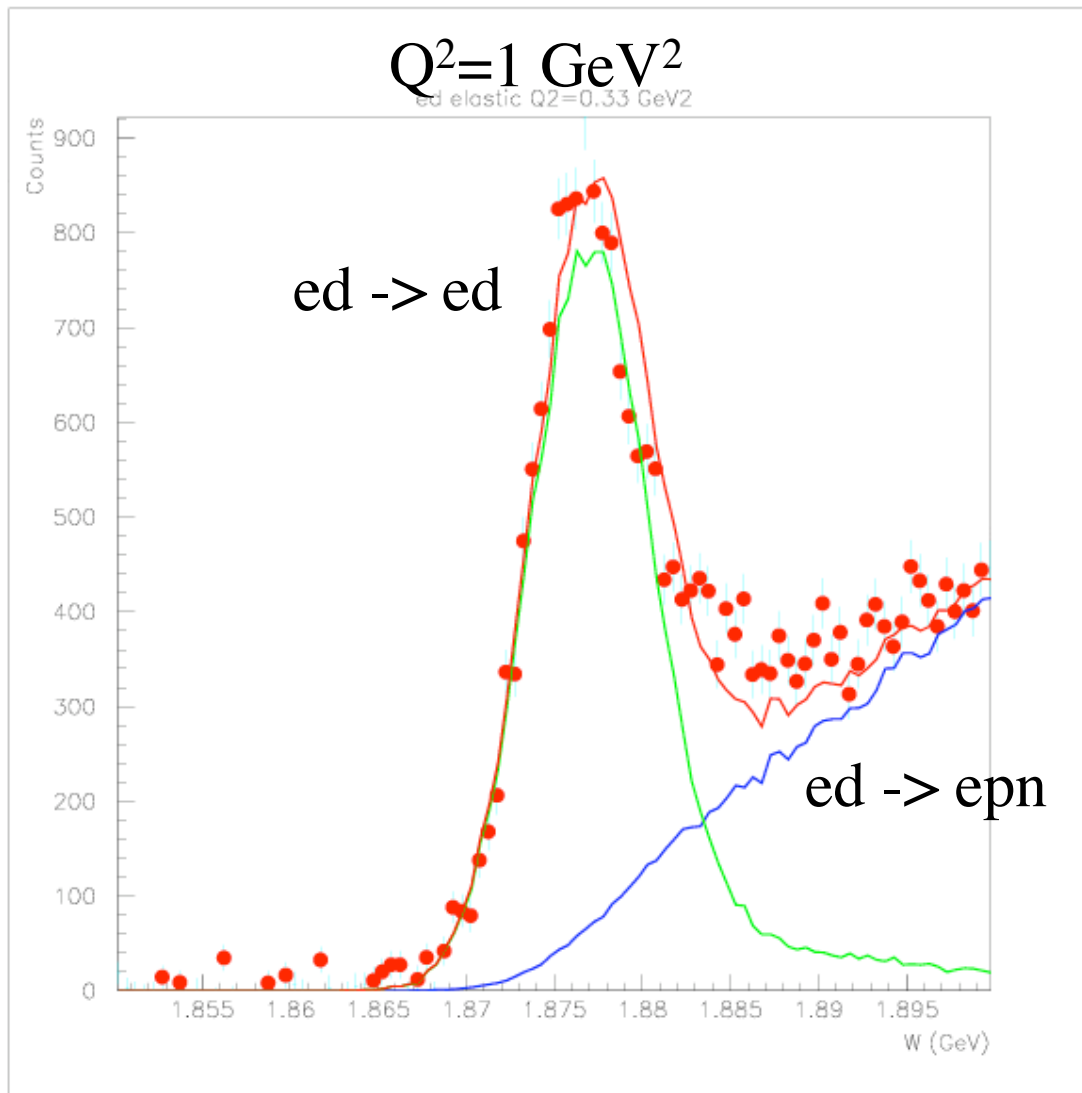
ed -> ed

ed -> epn

- ❑ **Endcap subtracted (big!)**
- ❑ **ed->ed from simplified SIMC and normalized to data by eye**
- ❑ **ed-> epn from J.M. Laget with resolution smearing and normalized to data**

W spectra from Jan 05
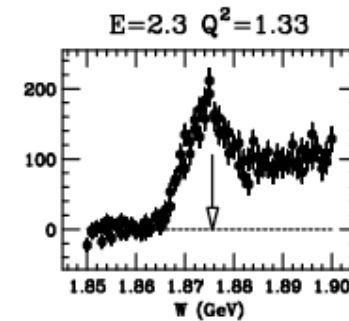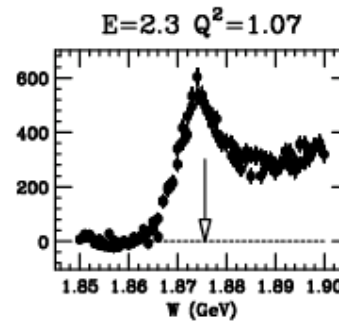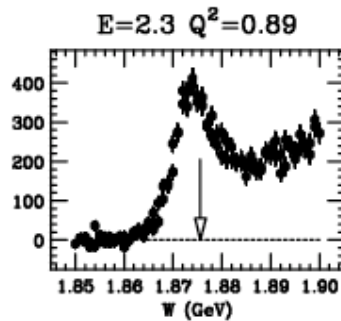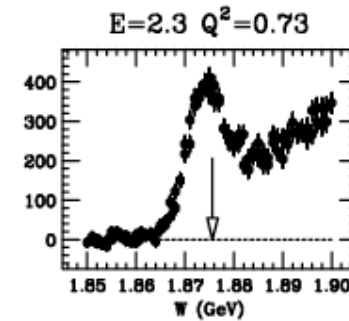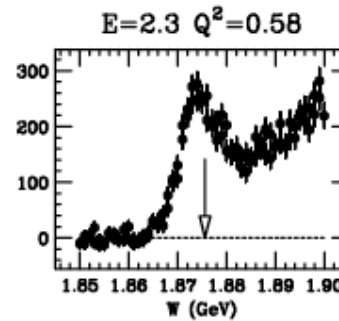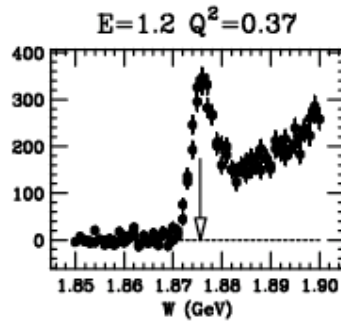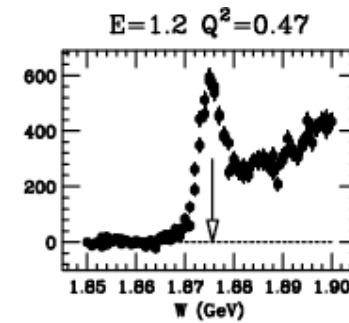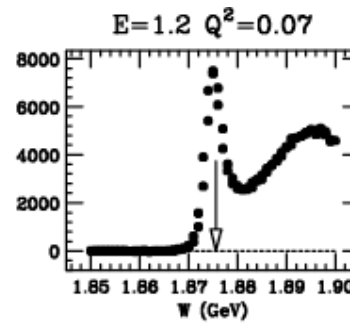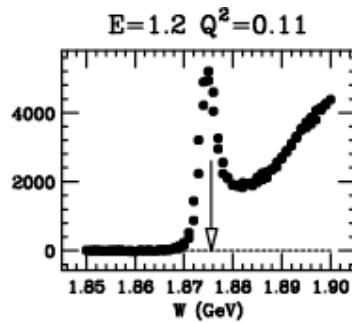
Corrections

❑ **Energy/angle calibration (used ep, ed, and even eC elastic peak positions).**

❑ **Detector efficiency, BCM calibration, target boiling, spectrometer aceptance…**

❑**Subtraction of Al windows.**

❑ **Subtraction of ed->epn. Used Arenhoevel model (only one with threshold enhancement) and put in rad. corr. code.**

❑ **Elastic rad. corr. (Mo and Tsai)**

❑ **Bincentering.**

❑ **Subtraction $B(Q^2)$ contributions**

Cross sections versus theta for each of the main settings of Jan 05, compared to fit of J. Ball.
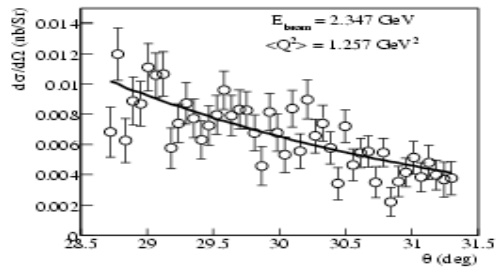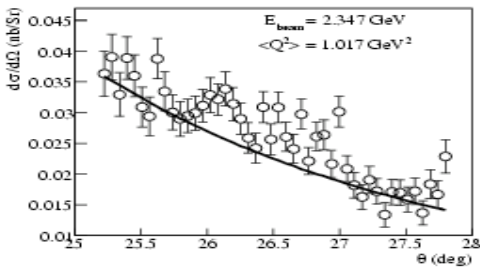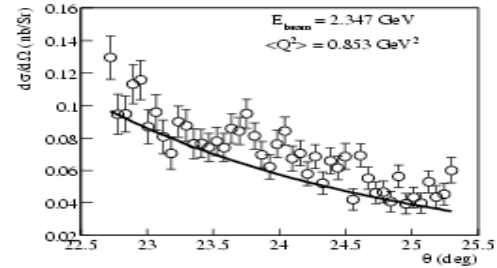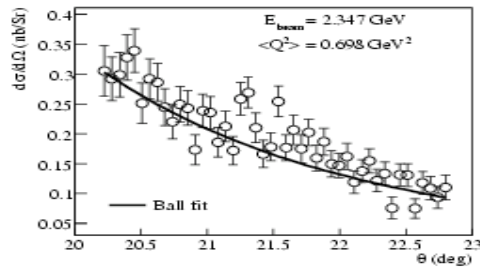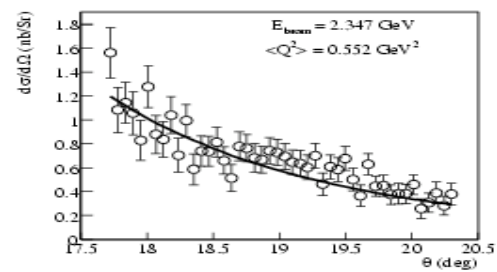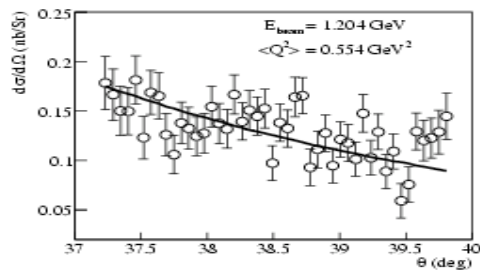
Final results from Jan 05 from v. Dharmawardane
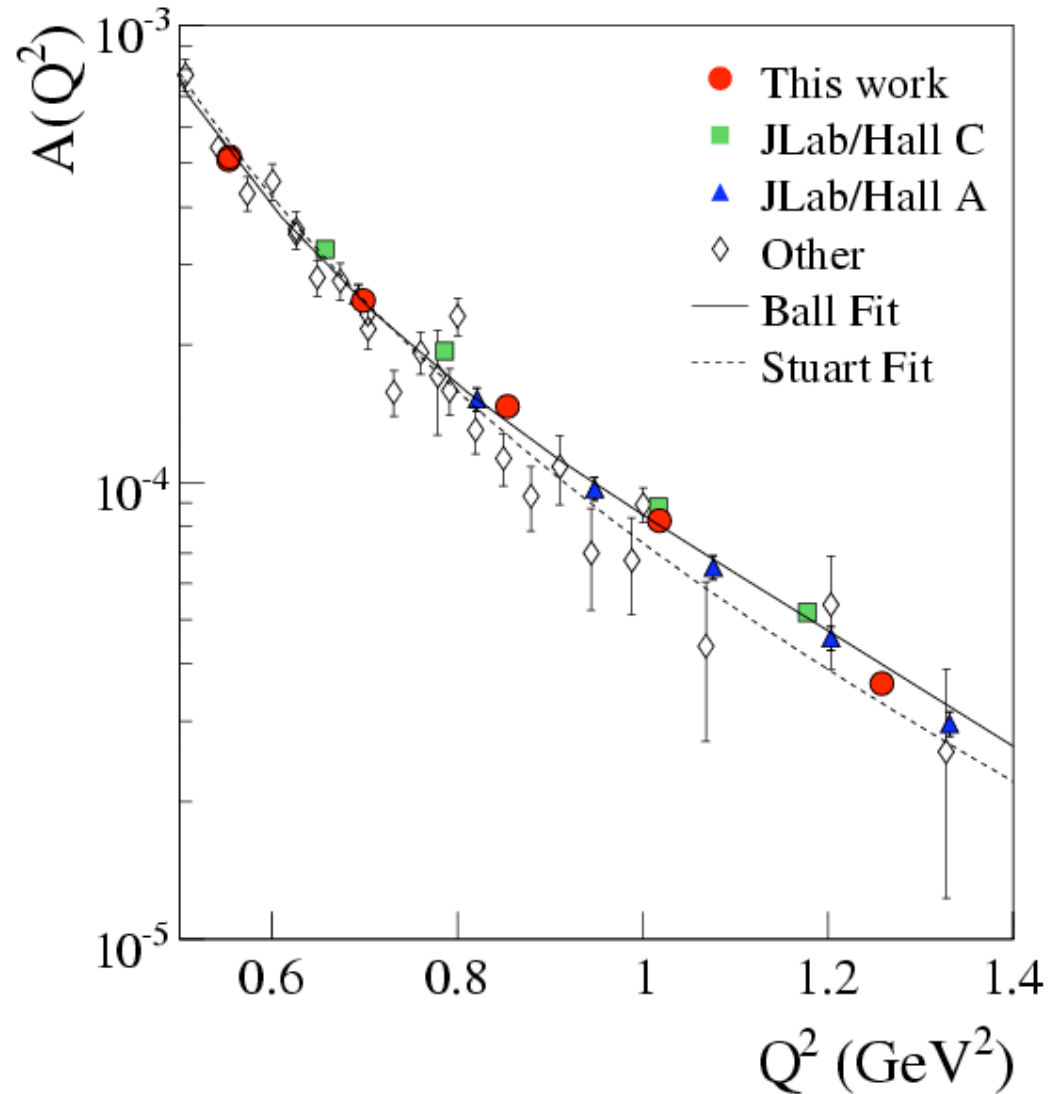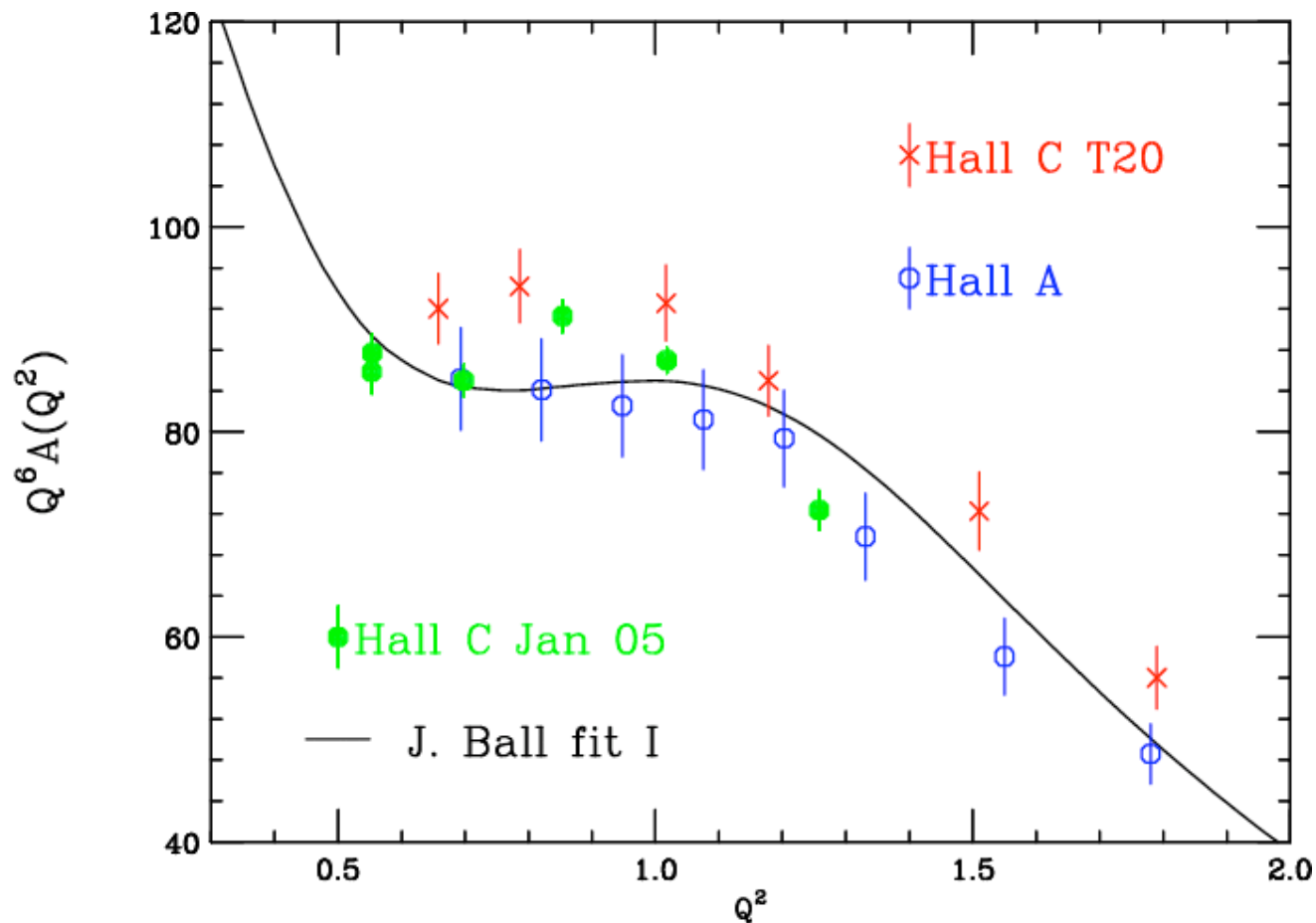
Jan05 results lie between Hall A and Hall C (T20), but on average a bit closer to Hall A. Systematic errors not included for Jan05 yet.

New fit to inclusive electron-proton scattering for $0<Q^2<8$ GeV^2, $W<3$ GeV

M.E. Christy and P.E. Bosted, arXiv:0711.0159)2007)

> Baed on new Hall C data.

> All 6 GeV Jlab kinematics.

> Fit to both F_1, F_2 (or F_2, R)

> Includes $Q^2=0$ constraint

> Constraints on resonances

> Used for radiative corrections

> Used for bin centering corrections

> Needed to get g_1 from A_1.

> Helpful in sum rule evaluations.

> Used predict neutrino xsections.
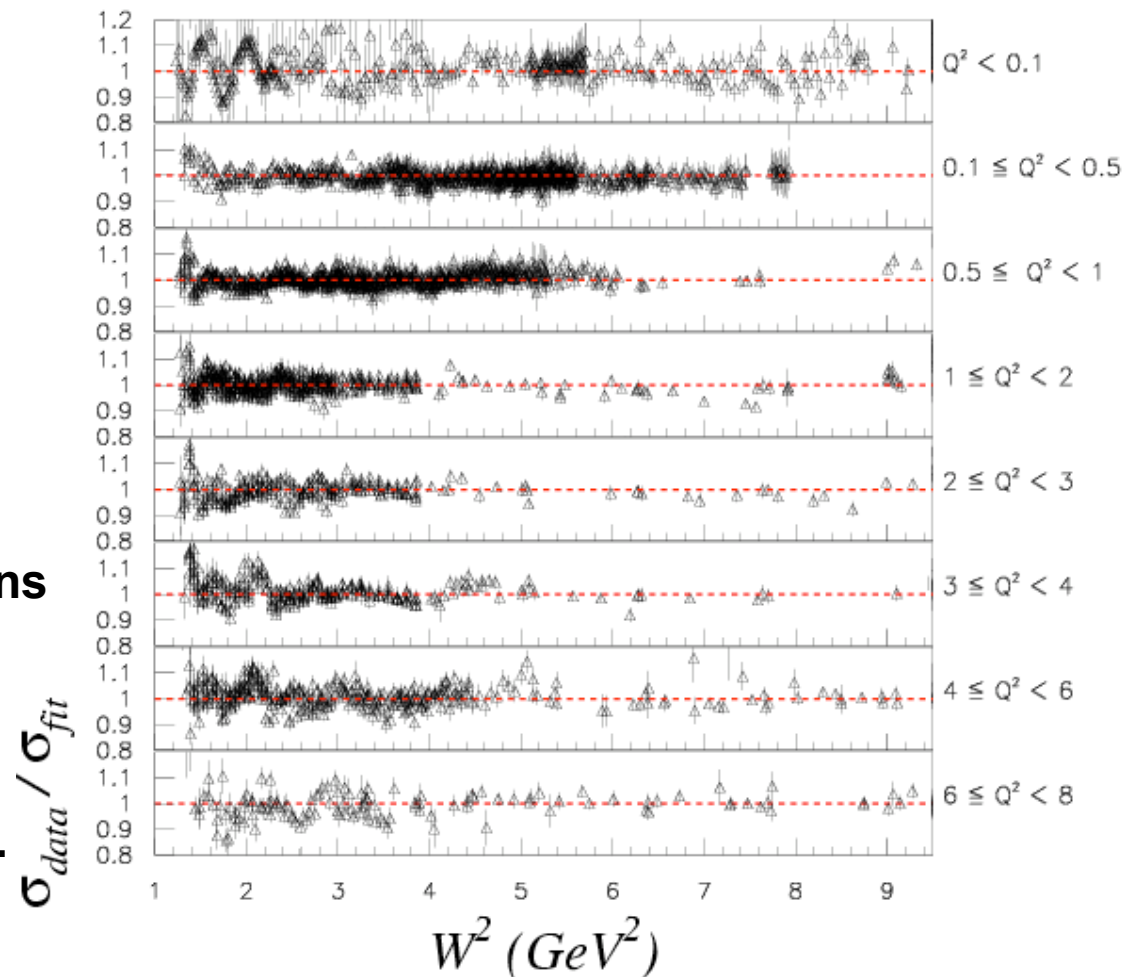
New fit to inclusive electron-deuteron scattering for $0<Q^2<10$ GeV^2, W<3.2 GeV

P.E. Bosted and M.E. Christy, arXiv: 0711.0159 (2007)

➤ **Baed on new Hall C, B data.**

➤ **All 6 GeV Jlab kinematics.**

➤ **Fit to F_1 (assumes $R_p = R_d$)**

➤ **Includes $Q^2 = 0$ constraint**

➤ **Good improvement over previous fit (dashed curves)**

➤ **Used for radiative and bin centering corrections**

➤ **Needed to get g_1 from A_1.**

➤ **Helpful in sum rule evaluations.**

➤ **Used predict neutrino xsections.**

➤ **Has been extended to A>2.**

➤ **More data to be added soon.**